

CLAIMS

What is claimed is:

1. An optical transducer, comprising:
 - a light source for emitting radiant energy;
 - a base member;
 - an elongate light collector positioned for receiving radiant energy from the light source, the elongate light collector comprising a tunnel formed in the base member and a collector window that extends along a length of the tunnel, such that radiant energy projected by the light source through the window is incident on the tunnel and transmitted along a length of the tunnel with a portion of the transmitted radiant energy exiting the tunnel to thereby vary the intensity of light along the tunnel length; and
 - at least one photosensor positioned for detecting the amount of radiant energy at a location in the tunnel;
 - wherein the intensity of radiant energy at the tunnel location is indicative of at least relative position between the incident radiant energy and the at least one photosensor.
2. An optical transducer according to claim 1, wherein the window is formed as an open gap in the base member.
3. An optical transducer according to claim 2, wherein a width of the gap is less than a cross dimension of the tunnel.
4. An optical transducer according to claim 1, wherein a width of the window is less than a cross dimension of the tunnel.
5. An optical transducer according to claim 1, wherein the light source and light collector are relatively movable to thereby vary the intensity of radiant energy at the tunnel location.
6. An optical transducer according to claim 1, and further comprising a light blocking member extending between the light source and at least a portion of the elongate light

collector for blocking at least a portion of the radiant energy from the light collector, the light blocking member and light collector being relatively movable for varying the position of the radiant energy incident on the light collector to thereby vary the amount of radiant energy transmitted to the tunnel location.

7. An optical transducer according to claim 6, wherein:

the base member comprises an elongate, tubular member having a central axis and a bore extending parallel to the central axis, the elongate light collector extending along a length of the tubular member for receiving, at least indirectly, radiant energy from the light source, the light collector having opposite ends such that radiant energy incident on a length of the light collector is transmitted to the light collector ends;

the light blocking member being located within the bore for blocking at least a portion of the radiant energy from the light collector, the light blocking member being movable in the bore with respect to the light collector for varying the position of the radiant energy incident on the light collector to thereby vary the amount of radiant energy transmitted to the tunnel location;

wherein the amount of radiant energy received by the light collector and detected by the at least one photosensor is indicative of relative movement between the tubular member and the light blocking member.

8. An optical transducer according to claim 7, wherein the light blocking member comprises at least one float that is adapted to ride on an upper surface of a liquid that may be present in the tubular member.

9. An optical transducer according to claim 8, wherein the light source is positioned at an upper end of the tubular member coincident with the bore.

10. An optical transducer according to claim 7, and further comprising a shaft having one end connected to the light blocking member and an opposite end extending out of the tubular member, wherein the amount of radiant energy received by the light collector and detected by the at least one photosensor is indicative of linear shaft movement.

11. An optical transducer according to claim 10, wherein the light blocking member is located between the light source and the at least one photosensor.

12. An optical transducer according to claim 6, wherein the light blocking member comprises an enclosed vial with a fluent light blocking material filling a portion of the vial, a window being formed at a position in the vial absent the fluent material;

wherein rotation of the optical transducer causes the fluent material to flow under gravity and thereby change the position of the window of the light blocking member and thus the position of the radiant energy incident on the light collector.

13. An optical transducer according to claim 12, wherein the fluent material comprises a relatively opaque liquid.

14. An optical transducer according to claim 13, wherein the fluent material comprises granular material.

15. An optical transducer according to claim 12, wherein the enclosed vial is arcuate-shaped, and the collector includes an arcuate-shaped section adjacent the vial.

16. An optical transducer according to claim 12, wherein the enclosed vial is ring-shaped, and the light collector includes a ring-shaped section adjacent the vial.

17. An optical transducer according to claim 6, wherein the light blocking member is located between the light source and the at least one photosensor.

18. An optical transducer according to claim 17, wherein the base member is positioned in a liquid and is adapted to extend beyond an upper surface of the liquid, the light blocking member comprising the upper surface of the liquid, such that the amount of radiant energy received by the light collector and detected by the at least one photosensor is indicative of liquid level.

19. An optical transducer according to claim 6, wherein the light blocking member comprises a disk rotatable about a central disk axis and a window formed on the disk, and further wherein the light collector has an arcuate section in alignment with the window of the light

5 blocking member, such that rotation of the disk about the central disk axis with respect to the light collector varies the position of the radiant energy incident on the arcuate section of the light collector to thereby indicate relative angular displacement between the disk and the light collector.

20. An optical transducer according to claim 19, wherein the light collector extends in a continuous circle such that a rotational position of the disk with respect to the light collector can be detected over 360 degrees.

21. An optical transducer according to claim 20, wherein the window of the light blocking member is arranged to project radiant energy into the tunnel at an acute angle with respect to a central axis of the tunnel.

22. An optical transducer according to claim 1, wherein the light source is arranged to project radiant energy into the tunnel at an acute angle with respect to a central axis of the tunnel.

23. An optical transducer according to claim 1, and further comprising a plurality of light collectors in side-by-side relationship, such that movement of the incident radiant energy across and along the light collectors can be detected.

24. An optical transducer according to claim 23, wherein each light collector has opposite ends, and further wherein the at least one photosensor comprises first and second photosensors positioned for detecting the intensity of radiant energy at the opposite ends of each light collector.

25. An optical transducer according to claim 1, wherein the at least one photosensor comprises first and second photosensors positioned for detecting the intensity of radiant energy in the tunnel at spaced locations.

26. An optical transducer according to claim 1, and further comprising a light blocking member having a flexible plate, a first end of the flexible plate being fixedly mounted with respect to the light source and a second free end adjacent the light collector, the free end being movable in response to an applied force to thereby change a length of the light collector exposed to the radiant energy.

27. An optical transducer according to claim 1, and further comprising a light blocking member having a relatively stiff plate, a first end of the plate being rotatably mounted with respect to the light source about a pivot joint and a second free end of the plate being adjacent the light collector, the plate being rotatable about the pivot joint in response to an applied force to thereby change a length of the light collector exposed to the radiant energy.

28. An optical transducer according to claim 1, wherein a portion of the transmitted radiant energy exits the tunnel through the window.

29. A method of detecting relative position between a first object and a second object, the method comprising:

forming an elongate light collector on the first object, the elongate light collector including a tunnel and a collector window that extends along a length of the tunnel;

projecting radiant energy into the tunnel from the second object;

transmitting the radiant energy along a length of the tunnel with a portion of the transmitted radiant energy exiting the tunnel to thereby vary the intensity of light along the tunnel length; and

detecting the amount of radiant energy at a location in the tunnel;

wherein the intensity of radiant energy at the tunnel location is indicative of the relative position between the first and second objects.

30. A method according to claim 29, wherein a portion of the transmitted radiant energy exits the tunnel through the window.

31. A method according to claim 29, wherein the window is formed as an open gap in the base member.

32. A method according to claim 31, wherein a width of the gap is less than a cross dimension of the open channel.

33. A method according to claim 29, wherein a width of the window is less than a cross dimension of the open channel.